

A new genus and species of cyproideid amphipod associated with unstalked crinoids on the Great Barrier Reef, Australia

J.K. LOWRY¹ & B.A.R. AZMAN²

¹*Crustacea Section, Australian Museum, 6 College Street, Sydney, NSW 2010, Australia. E-mail: jim.lowry@austmus.gov.au*

²*Marine Ecosystem Research Centre (EKOMAR), Faculty of Science & Technology Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia. E-mail: abarahim@gmail.com*

Abstract

Gbroidea dingaalana, a new genus and species of cyproideid amphipod is described from Lizard Island, Great Barrier Reef, Australia. The species is associated with the unstalked crinoids, *Comathus briareus*, *Comatula rotalaria* and *Zygometra microdiscus*.

Key words: Crustacea, Amphipoda, Cyproideidae, *Gbroidea dingaalana*, new genus, new species, Great Barrier Reef, Australia, taxonomy

Introduction

The Cyproideidae J.L. Barnard, 1974 is a well-defined family of 18 genera living mainly in the Indo-West Pacific (Fig. 1). They are small, brightly coloured amphipods, often associated with other invertebrates such as hydroids, sea fans, bryozoans, soft corals and crinoids (Potts 1915; Moore 1992), but some also occur on algae. There are currently approximately 43 species in the family, but many more species await discovery (J.L. Barnard 1972). For instance, although cyproideids are most diverse in the Indo-West Pacific, none are currently recorded from the South China Sea, the west coast of India or the east coast of Africa. The majority of cyproideid generic level diversity is in the Indo-West Pacific (11 of 18 genera). Within this region the greatest diversity occurs in Australia and the south-western Indian Ocean. In this paper we describe the first tropical Australian cyproideid, *Gbroidea dingaalana* gen. et sp. nov.

Methods

The generic diagnosis was generated from a DELTA database (Dallwitz 2005) to the cyproideid genera of the world. All material is lodged in the Australian Museum, Sydney (AM). Crinoids were collected by diving and placed in individual bags. When placed in white enamel sorting trays the tiny, deep brown amphipods left the crinoids and were collected from the bottom of the tray. The following abbreviations are used on the plates: **A**, antenna; **G**, gnathopod; **HD**, head; **LL**, lower lip; **MD**, mandible; **MP**, maxilliped; **MX**, maxilla; **P**, pereopod; **PL**, pleopod; **T**, telson; **U**, uropod; **UR**, urosomite.

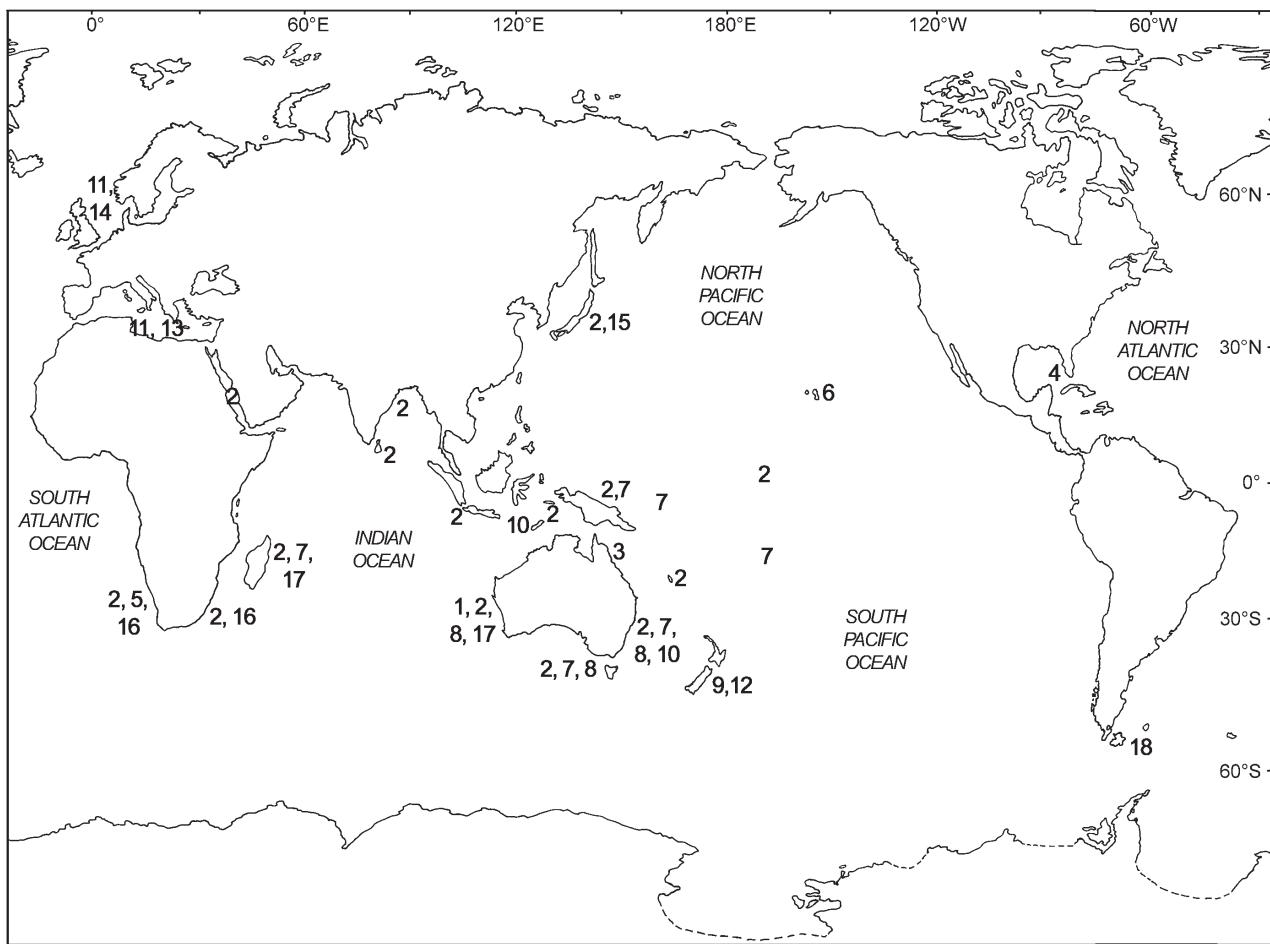


FIGURE 1. Geographic distribution of cyproideid genera: 1. *Austropheonoides* J.L. Barnard, 1972; 2. *Cyproidea* Haswell, 1879; 3. *Gbroidea* gen. nov.; 4. *Hoplopheonoides* Shoemaker, 1956; 5. *Hoplopleon* K.H. Barnard, 1932; 6. *Mokuloe* J.L. Barnard, 1970; 7. *Moolapheonoides* J.L. Barnard, 1974; 8. *Narapheonoides* J.L. Barnard, 1972; 9. *Neocyproidea* Hurley, 1955; 10. *Paracyproidea* Stebbing, 1899; 11. *Peltocoxa* Catta, 1875; 12. *Peltopes* K.H. Barnard, 1930; 13. *Pseudopeltocoxa* Schiecke, 1977; 14. *Stegoplax* G.O. Sars, 1883; 15. *Terepeltopes* Hirayama, 1983; 16. *Unguja* Griffiths, 1976; 17. *Unyapheonoides* J.L. Barnard, 1972; 18. *Victorhensenoides* Rauschert, 1996.

Cyproideidae J.L. Barnard, 1974

Diagnosis. Coxae 1 and 2 vestigial, hidden or partially hidden by coxa 3. Coxae 3 and 4 extensively widened, forming a large coxal shield. Uropods 1 and 2, rami without apical robust setae. Uropod 3 biramous. Telson entire or notched.

Included genera. Cyproideidae includes 18 genera: *Austropheonoides* J.L. Barnard, 1972; *Cyproidea* Haswell, 1879; *Gbroidea* gen. nov.; *Hoplopheonoides* Shoemaker, 1956; *Hoplopleon* K.H. Barnard, 1932; *Mokuloe* J.L. Barnard, 1970; *Moolapheonoides* J.L. Barnard, 1974; *Narapheonoides* J.L. Barnard, 1972; *Neocyproidea* Hurley, 1955; *Paracyproidea* Stebbing, 1899; *Peltocoxa* Catta, 1875; *Peltopes* K.H. Barnard, 1930; *Pseudopeltocoxa* Schiecke, 1977; *Stegoplax* G.O. Sars, 1883; *Terepeltopes* Hirayama, 1983; *Unguja* Griffiths, 1976; *Unyapheonoides* J.L. Barnard, 1972; *Victorhensenoides* Rauschert, 1996.

Remarks. The Cyproideidae is a distinctive, tightly defined family. The combination of coxae 1 and 2 vestigial, coxae 3 and 4 extensively broadened and uropod 3 biramous distinguish this family from all others.

Gbroidea gen. nov.

Type species. *Gbroidea dingaalana* sp. nov., present designation.

Included species. *G. dingaalana* sp. nov.

Etymology. “*Gbroidea*” is based on the initials of the Great Barrier Reef combined with the ending from some other cyproideid genera.

Diagnosis. Head lateral cephalic lobe narrowly rounded apically. Head rostrum small to medium in size. *Antenna 1* accessory flagellum present. *Antenna 2* slender. *Mandible* molar absent; palp well developed. *Maxilla 1* palp 1-articulate. *Maxilliped* outer plate reaching end of palp article 1. *Gnathopod 1* simple; carpal lobe present, extending slightly along propodus posterior margin; propodus subrectangular; dactylus inner margin multispinous. *Gnathopod 2* nearly simple; carpal lobe extending slightly along propodus posterior margin; dactylus, inner margin with 1 spine. *Pereopod 5* basis rectilinear. *Pereopod 6* basis rectilinear. *Pereopod 7* basis expanded, subovate. *Pleonite 3* without dorsodistal process. *Epimeron 3* posteroventral corner broadly rounded. *Urosomite 1* elongate, without dorsal keel. *Urosomite 3* not projecting over telson. *Uropod 2* very long, reaching beyond apex of uropod 3. *Telson* laminar, shorter than apex of uropod 3 rami.

Remarks. Genera in the Cyproideidae are diagnosed by a set of discrete characters based on the gnathopods, the basis of pereopods 5–7 and the urosomites. Within this set *Gbroidea* is highly distinctive. Considering the simple first and second gnathopods, *Gbroidea* is most similar to *Peltipes*. Considering the rectilinear basis on pereopods 5 and 6 and expanded, subovate basis of pereopod 7, *Gbroidea* is most similar to *Cyproidea* and *Mokuoloe*. The elongate urosomite 1 without a dorsal keel is unique to *Gbroidea*. Only *Cyproidea* and *Gbroidea* have the molar vestigial or absent.

Gbroidea dingaalana sp. nov.

(Figs 2–4)

Type material. Holotype female, 2.5 mm, AM P76155, off Watsons Beach, Lizard Island, Queensland, Australia (14°40'S 145°28'E), living in association with the zygometrid crinoid, *Zygometra microdiscus* (Bell, 1882), 21 m, stn QLD 2010, R.T. Springthorpe, 10 February 1987. Paratypes: 2 females, AM P38471, stn QLD 2011; 4 females, AM P38472, off Watsons Beach, Lizard Island, Queensland, Australia (14°40'S 145°28'E), living in association with *Comathus briareus* (Bell, 1882), *Comatula rotalaria* Lamarck, 1816 and *Zygometra microdiscus* (Bell, 1882), 21 m, stn QLD 2011, R.T. Springthorpe, 10 February 1987; 4 females, AM P38473, stn QLD 2010.

Type locality. Off Watsons Beach, Lizard Island, Queensland, Australia (14°40'S 145°28'E), living in association with the unstalked zygometrid crinoid, *Zygometra microdiscus* (Bell, 1882), 21 m.

Etymology. The species name, *dingaalana*, is based on the aboriginal tribe that visited Lizard Island before it was occupied by Europeans.

Description. Based on holotype female, 2.5 mm, AM P76155.

Head. Lateral cephalic lobes apically acute. Eyes large, irregularly round with deep brown core. *Antenna 1* flagellum with about 4 articles each with long aesthetascs distally; accessory flagellum 1 articulate. *Antenna 2* slightly shorter than antenna 1, slender; flagellum with 4 articles, apex of terminal segment with few long setae. *Mandible* molar absent. *Maxilla 2* reduced. *Lower lip* outer lobes apically produced with dense short apical setae. *Maxilliped* inner and outer plates reduced; inner plate not broad, apically truncate; outer plate extending beyond inner plate, apex with one small robust seta and several simple setae; palp 4-articulate, article 2 wider than long, dactylus apically falcate.

Pereon. *Gnathopod 1* coxa vestigial; basis robust, anterior margin with 4 medium length setae, posterior margin with 1 seta posterodistally; merus not elongated, posterior margin with two setae; carpus distally

expanded, anterodistally rounded with a pair of setae, posterior margin slightly produced with 3 posterodistal setae; propodus subrectangular, anterior margin with 3 setae, tooth-like process anterodistally, posterior margin straight; dactylus falcate. *Gnathopod 2* basis robust, anterior margin lined with medium length setae, posterior margin without setae; merus posterodistal margin with long setae; carpus subtriangular, subequal in length with propodus, anterior margin without setae, anterodistal margin with two setae. *Pereopod 3* coxa anterior margin expanded, rounded, posterior margin slightly concave; basis anterior margin densely setose; merus gradually expanding anterodistally. *Pereopod 4* coxa enlarged, shield-like, anterior margin almost straight, posterior margin with well developed rounded posterodistal margin; basis anterior margin straight, posterior margin slightly concave. *Pereopod 5* coxa anterior and posterior margin rounded; basis slender, rectilinear; merus posterodistal margin slightly produced. *Pereopod 7* shorter than pereopod 6; coxa anteroventral margin produced, expanded; basis anterior margin straight, with 2 setae along margin, posterior margin expanded, with distal lobe extending beyond ischium.

Pleon. *Epimeron 3* posterodistal margin rounded. *Uropod 1* rami subequal, peduncle slightly shorter than rami, both margins of both rami pectinate. *Uropod 2* biramous, inner ramus shorter than outer ramus, both margins of both rami pectinate. *Uropod 3* biramous; peduncle subequal in length of inner ramus; inner ramus shorter than outer, outer margins pectinate. *Telson* entire.

Male. Unknown.

Colour. Antennae, head, eye, pereon and coxae deep brown with a diffused white stripe between pereon and coxae and between coxae 3–4; gnathopods, pereopods, pleopods, uropods and urosome translucent.

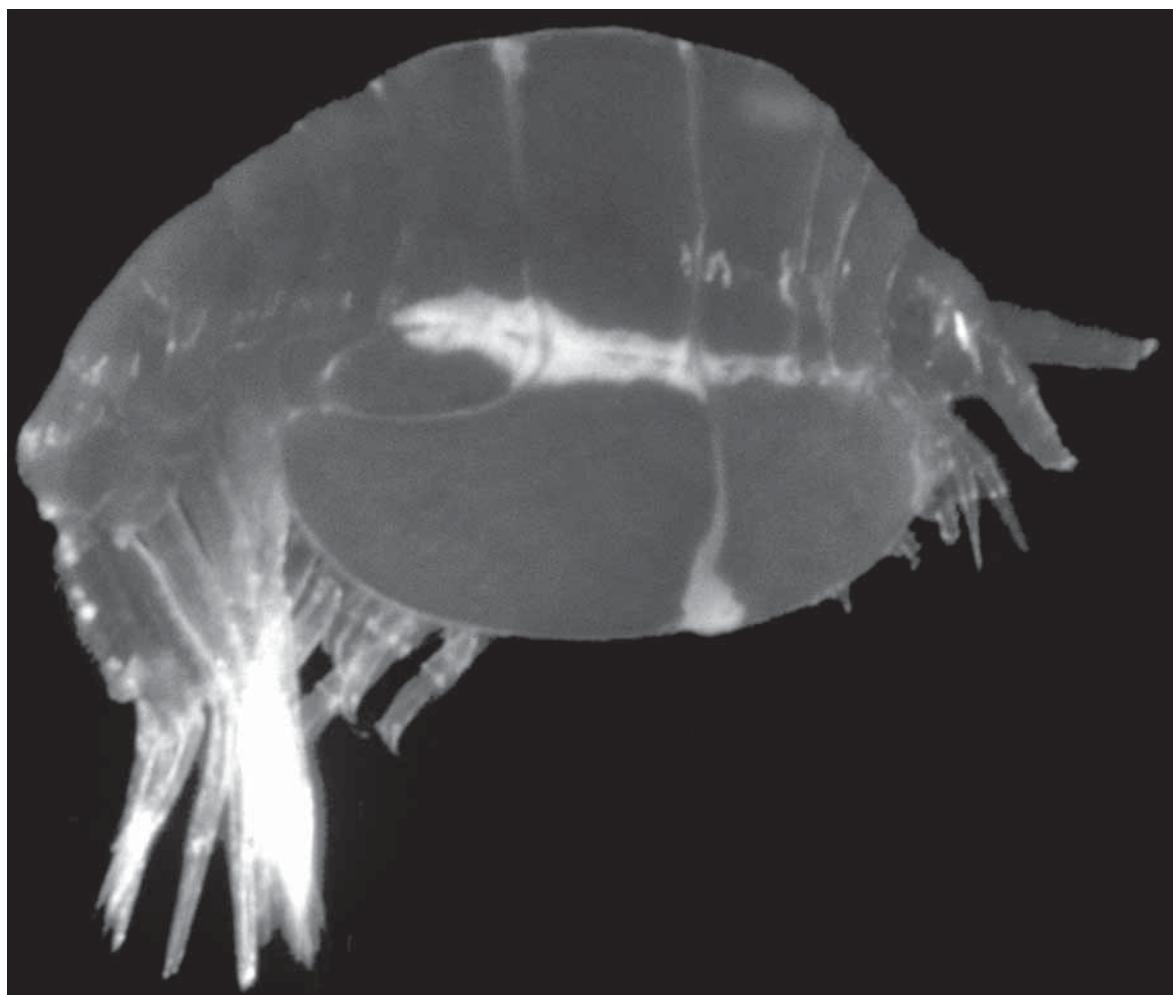


FIGURE 2. *Gbroidea dingaalana* sp. nov., female paratype, AM P38471, off Watsons Beach, Lizard Island.

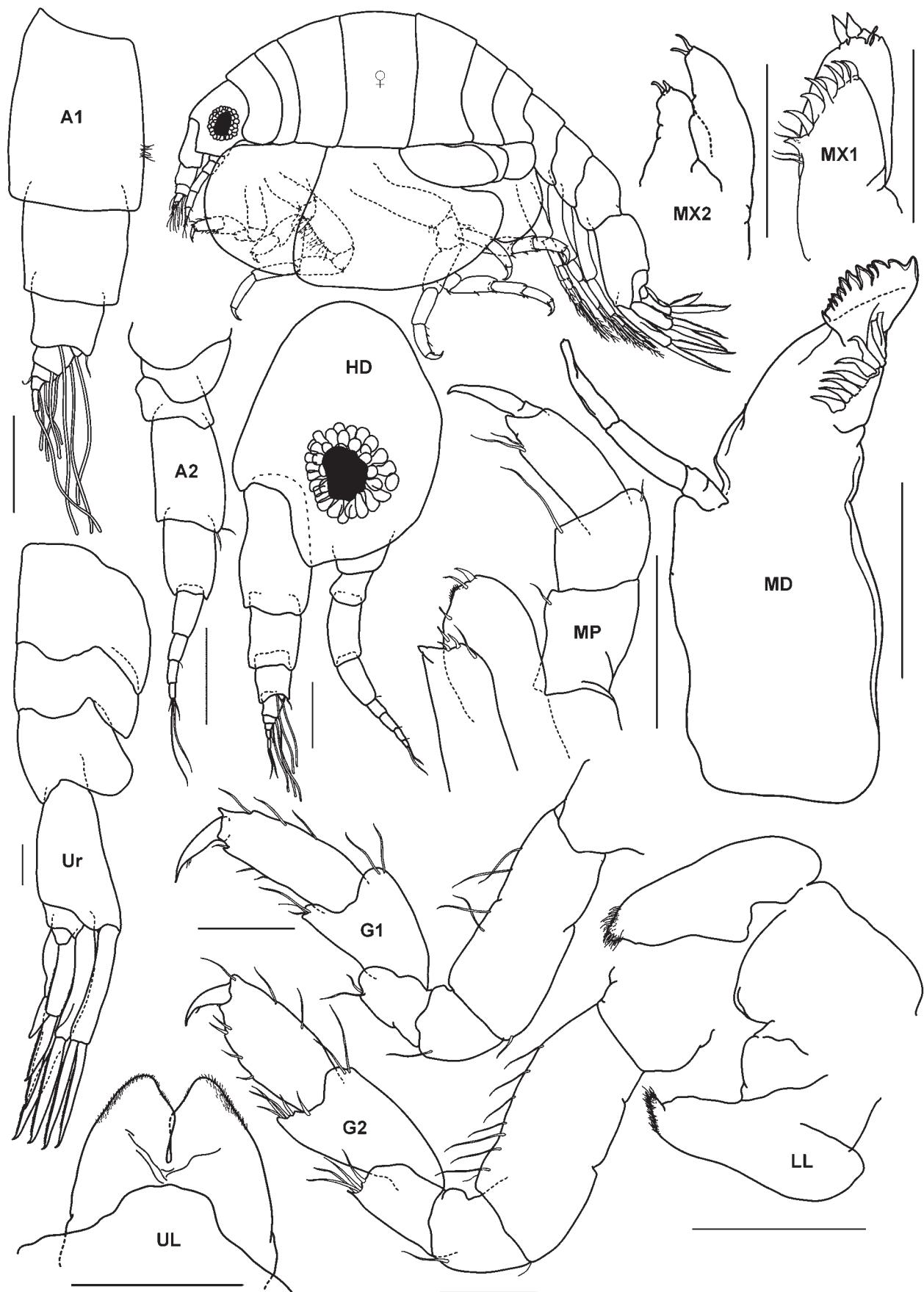


FIGURE 3. *Gbroidea dingleana* sp. nov., holotype female, 2.5 mm, AM P76155, off Watsons Beach, Lizard Island.

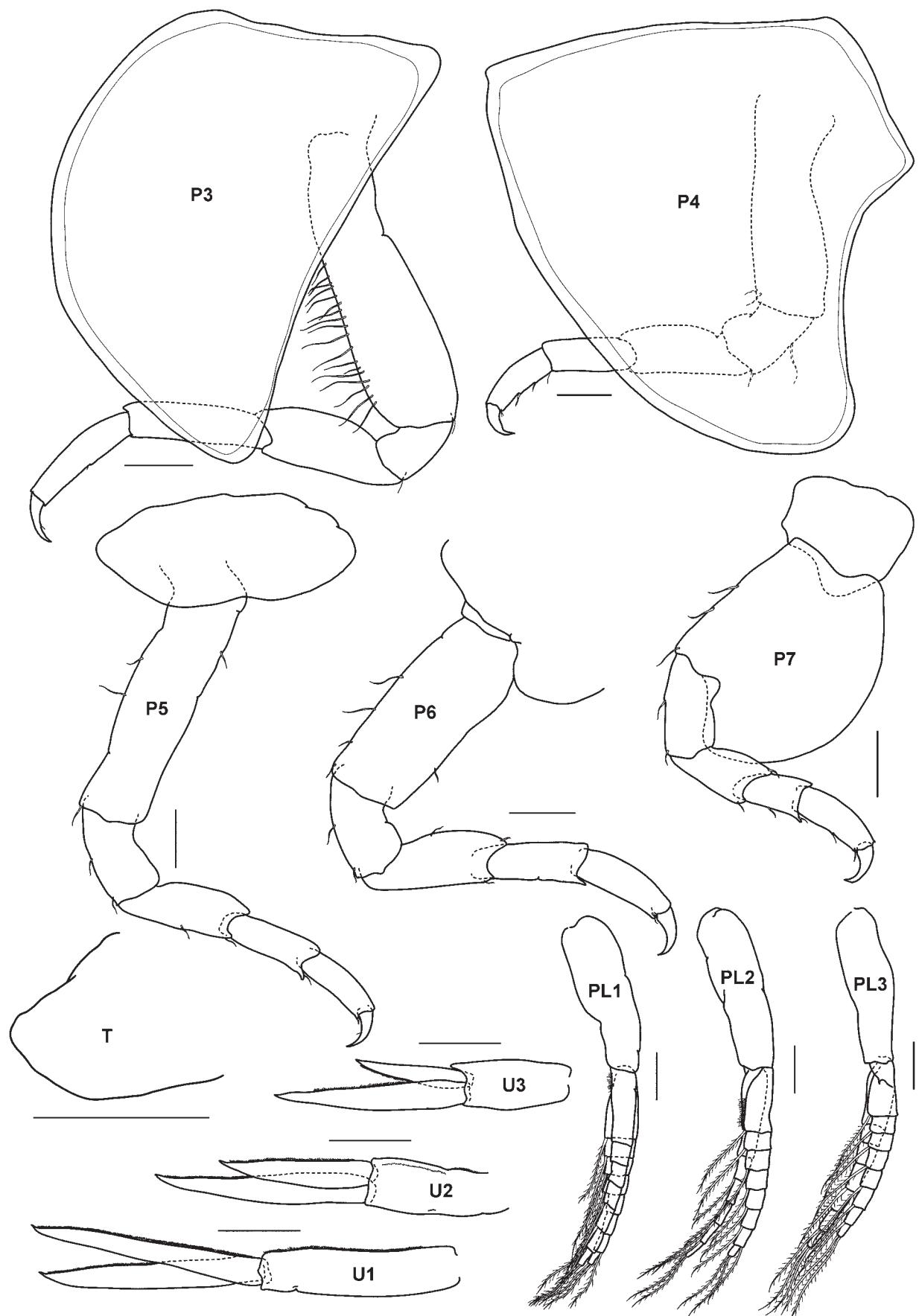


FIGURE 4. *Gbroidea dingaalana* sp. nov., holotype female, 2.5 mm, AM P76155, off Watsons Beach, Lizard Island.

Habitat. Living in association with the crinoids, *Comathus briareus* (Bell, 1882), *Comatula rotalaria* Lamarck, 1816 and *Zygometra microdiscus* (Bell, 1882).

Remarks. *Gbroidea dingaalana* is the only cyproideid amphipod currently known from the Great Barrier Reef. During a 1987 expedition to Lizard Island, M. Grygier, J. Lowry and R. Springthorpe examined 10 specimens of three crinoids: *Comathus briareus*, *Comatula rotalaria* and *Zygometra microdiscus*. There were 11 specimens of *G. dingaalana* living on these crinoids or about 1 amphipod per host. We suspect that *G. dingaalana* has evolved an obligate commensal relationship with unstalked crinoids or is possibly an epiparasite. *Comathus briareus* and *Comatula rotalaria* are both deep brown in colour and *Zygometra microdiscus* is deep purple. The deep brown camouflage colouration of *G. dingaalana* makes it undetectable on the crinoid hosts and by inference, less susceptible to predators. The weakly developed mouthparts of *G. dingaalana* indicate that it is probably feeding on sloughed mucous or soft tissue, possibly epidermal tissue from the crinoid, similar to the uristid amphipod, *Euonyx chelatus*, which is an epiparasite of the regular sea urchin, *Echinus esculentus* (see Vader 1978; Comely & Ansell 1988). We only have information from three species of unstalked crinoids, but Messing *et al.* (2006) found 12 species of unstalked crinoids at Lizard Island. Interestingly Potts (1915) reported a purple amphilochid amphipod, *Cyclotelson purpureum*, associated with an unnamed crinoid, from Torres Strait. We did not find this species at Lizard Island.

Distribution. *Australia*: Queensland: Lizard Island.

Discussion

Indo-Pacific Genera

Of the eleven cyproideid genera known from the Indo-West Pacific, four are widespread: *Cyproidea* Haswell, 1879, *Moolapheonoides* J.L. Barnard, 1974, *Paracyproidea* Stebbing, 1899 and *Unyapheonoides* J.L. Barnard, 1972. *Cyproidea*, the most widely distributed genus, has been reported from Japan (Hirayama 1978), Kiribati (Schellenberg 1938), New Caledonia (Ledoyer 1984), Australia (Haswell 1879; J.L. Barnard 1972, 1974; Moore 1981), Papua New Guinea (Schellenberg 1938), Indonesia (Ledoyer 1979), India (Nayar 1966), Sri Lanka (Walker 1904), Red Sea (Ruffo 1938, 1959, 1969), Madagascar (Ledoyer 1967, 1982) and southern Africa (Spandl 1924; K.H. Barnard 1925, 1940; Schellenberg 1953; Griffiths 1974a-c, 1976). *Moolapheonoides* is known from Australia (J.L. Barnard 1974), Fiji (Myers 1985), Madagascar (Ledoyer 1982) and Papua New Guinea (Thomas 1999). *Paracyproidea* is known from Australia (Moore 1992) and Indonesia (Moore 1992) and *Unyapheonoides* is known from Australia (J.L. Barnard 1972) and Madagascar (Ledoyer 1982).

Other genera from the Indo-West Pacific have restricted distributions. *Mokuoloe* J.L. Barnard, 1970, is known only from Hawaii. *Terepeltopes* Hirayama, 1983, is known only from Japan. In New Zealand there are two endemic genera, *Neocyproidea* Hurley, 1955 and *Peltipes* K.H. Barnard, 1930. In Australia there are three endemic genera: *Austropheonoides* J.L. Barnard, 1972; *Gbroidea* gen. nov.; and *Narapheonoides* J.L. Barnard, 1972. In the Indian Ocean the genera are more widely distributed with no endemics.

Atlantic-Mediterranean Genera

Southern Africa has three genera: *Cyproidea*; *Hoplopleon* K.H. Barnard, 1932; and *Unguja* Griffiths, 1976, the latter two are endemic. *Cyproidea* and *Unguja* are known from both coasts. All three species of *Hoplopleon* are currently known only from the south-eastern Atlantic.

Three genera are known from the Mediterranean Sea and the north-eastern Atlantic Ocean. *Peltocoxa* Catta, 1875 occurs in both areas (Lincoln 1979; Krapp-Schickel 1982). *Pseudopeltocoxa* Schiecke, 1977 is endemic to the Mediterranean and *Stegoplax* G.O. Sars, 1883 is endemic to the north-eastern Atlantic.

Hoplopheonoides Shoemaker, 1956 is endemic to the Gulf of Mexico and Caribbean Sea in the western Atlantic Ocean (Shoemaker 1956; Ortiz *et al.* 2000). Recently *Victorhensenoides* Rauschert, 1996 was described from the Magellanic area in the south-eastern Atlantic.

It appears that cyproideids do not occur in the eastern Pacific Ocean, the North Polar Sea or the Antarctic.

Distribution in relation to climate zones

Of the 18 known genera only three are confined to the tropics (*Gbroidea*, *Hoplopheonoides* and *Mokuoloe*) and another four are represented in both tropical and temperate regions (*Cyproidea*, *Moolapheonoides*, *Paracyproidea* and *Unyapheonoides*). A more significant number of genera occur in temperate environments on either side of the tropics with five in the northern hemisphere (*Cyproidea*, *Peltocoxa*, *Pseudopeltocoxa*, *Stegoplax* and *Terepeltopes*) and nine in the southern hemisphere (*Austropheonoides*, *Cyproidea*, *Moolapheonoides*, *Narapheonoides*, *Neocyproidea*, *Paracyproidea*, *Peltipes*, *Unyapheonoides* and *Victorhensenoides*). *Cyproidea* is the only taxon present in all of these areas.

Biogeography

The family was probably widespread around Pangaea, around the northern and southern shores of the Tethys Ocean. The eastern North Atlantic, Mediterranean and Japanese endemics, *Peltocoxa*, *Pseudopeltocoxa*, *Stegoplax* and *Terepeltopes* are classic Tethyan relicts. Today, the family is distinctively anti-tropical, suggesting that few genera have been able to fill vacant niches, or outcompete niche holders in the tropics, but have been able to undergo adaptive radiation in temperate environments in both hemispheres.

One might expect a close phylogenetic relationship between the Hawaiian endemic *Mokuoloe* and the Caribbean endemic *Hoplopheonoides*, with a Hawaiian-Caribbean link already demonstrated for amphipods (Myers 1991). One might also expect the Magellanic endemic *Victorhensenoides* to be more closely related to the New Zealand endemics, *Neocyproidea* and *Peltipes*, than to other cyproideid genera. A phylogenetic analysis of this group is required.

Acknowledgements

We thank Anne Hoggett, Lizard Island Research Station for the identification of the host crinoids, Lauren Hughes, Australian Museum and Alan Myers, National University of Ireland Cork, for their perceptive comments and improvements on the manuscript and Roger Springthorpe, Australian Museum for the colour picture of *Gbroidea dingaalan*.

References

Barnard, J.L. (1970) Sublittoral Gammaridea (Amphipoda) of the Hawaiian Islands. *Smithsonian Contributions to Zoology*, 34, 1–286.

Barnard, J.L. (1972) Gammaridean Amphipoda of Australia, Part I. *Smithsonian Contributions to Zoology*, 103, 1–333.

Barnard, J.L. (1974) Gammaridean Amphipoda of Australia, Part II. *Smithsonian Contributions to Zoology*, 139, 1–148.

Barnard, K.H. (1925) Contributions to the crustacean fauna of South Africa. No. 8. Further additions to the list of Amphipoda. *Annals of the South African Museum*, 20, 319–380, pl. 34.

Barnard, K.H. (1930) Crustacea. Part XI. — Amphipoda. *British Antarctic ("Terra Nova") Expedition, 1910, Natural History Reports, Zoology*, 8, 307–454.

Barnard, K.H. (1932) Amphipoda. *Discovery Reports*, 5, 1–326, pl. 1.

Barnard, K.H. (1940) Contributions to the crustacean fauna of South Africa. 12. Further additions to the Tanaidacea, Isopoda, and Amphipoda, together with keys for the identification of the hitherto recorded marine and fresh-water species. *Annals of the South African Museum*, 32, 381–543.

Catta, J.D. (1875) Note pour servir a l'histoire des amphipodes du Golfe de Marseille. *Revue Des Sciences Naturelles*,

Montpellier, 4(1), 161–169.

Comely, C.A. & Ansell, A.D. (1988) Invertebrate associates of the sea urchin, *Echinus esculentus* L., from the Scottish west coast. *Ophelia*, 28(2), 111–137.

Dallwitz, M.J. (2005) Overview of the DELTA System. <http://delta-intkey.com/www/overview.htm>. 23/4/2006.

Griffiths, C.L. (1974a) The Amphipoda of southern Africa. Part 2. The Gammaridea and Caprellidea of South West Africa south of 20°S. *Annals of the South African Museum*, 62(6), 169–208.

Griffiths, C.L. (1974b) The Amphipoda of southern Africa. Part 3. The Gammaridea and Caprellidea of Natal. *Annals of the South African Museum*, 62(7), 209–264.

Griffiths, C.L. (1974c) The Amphipoda of southern Africa. Part 4. The Gammaridea and Caprellidea of the Cape Province east of Cape Agulhas. *Annals of the South African Museum*, 65(9), 251–336.

Griffiths, C.L. (1976) Some new and notable Amphipoda from southern Africa. *Annals of the South African Museum*, 72(2), 11–35.

Haswell, W.A. (1879) On some additional new genera and species of amphipodous crustaceans. *Proceedings of the Linnean Society of New South Wales*, 4(4), 319–350, pls 18–24.

Hirayama, A. (1978) A new species of the amphipod genus *Cyproidea* from Amakusa, Kyushu. *Publications From the Amakusa Marine Biological Laboratory*, 4(3), 245–251.

Hirayama, A. (1983) Taxonomic studies on the shallow water gammaridean Amphipoda of West Kyushu, Japan. I. Acanthonotozomatidae, Ampeliscidae, Ampithoidae, Amphilochidae, Anamixidae, Argissidae, Atylidae and Colomastigidae. *Publications of the Seto Marine Biological Laboratory*, 28, 75–150.

Hurley, D.E. (1955) Studies on the New Zealand amphipodan fauna. No. 12. The marine families Stegocephalidae and Amphilochidae. *Transactions of the Royal Society of New Zealand*, 83(1), 195–221.

Krapp-Schickel, G. (1982) Family Amphilochidae. *Mémoires De L'Institut Océanographique, Monaco*, 13, 70–93.

Lincoln, R.J. (1979) British Marine Amphipoda: Gammaridea. London: British Museum (Natural History), i–v, 1–658.

Ledoyer, M. (1967) Amphipodes gammariens des herbiers de phanérogames marines de la région de Tuléar (République Malgache). *Étude systématique et écologique. Annales De L'Université De Madagascar*, 5, 121–170.

Ledoyer, M. (1979) Expédition Rumphius II (1975) Crustacés parasites, commensaux, etc. (Th. Monod et R. Serene, ed.) VI. Crustacés Amphipodes Grammariens. *Bulletin Du Muséum National D'Histoire Naturelle, Paris, Series 4, Section A*, 1, 137–181.

Ledoyer, M. (1982) Crustacés amphipodes gammariens. Familles des Acanthonotozomatidae à Gammaridae. *Faune De Madagascar*, 59(1), 1–598.

Ledoyer, M. (1984) Les gammariens (Crustacea, Amphipoda) des herbiers de phanérogames marines de Nouvelle Calédonie (région de Nouméa). *Mémoires Du Muséum National D'Histoire Naturelle, Series A, Zoology*, 129, 1–113.

Messing, C.G., Meyer, D.L., Siebeck, U.E., Jermin, L.S., Vaney, D.I. & Rouse, G.W. (2006) A modern soft-bottom, shallow-water crinoid fauna (Echinodermata) from the Great Barrier Reef, Australia. *Coral Reefs*, 25(1), 164–168.

Moore, P.G. (1981) Marine Amphipoda (Crustacea) new to science from the Tasmanian phytal fauna. *Journal of Natural History*, 15, 939–964.

Moore, P.G. (1992) Clarification and amplification of the genus *Paracyproidea* (Amphipoda: Amphilochidae), including a description of a new species. *Journal of Natural History*, 26(2), 373–381.

Myers, A.A. (1985) Shallow-water, coral reef and mangrove Amphipoda (Gammaridea) of Fiji. *Records of the Australian Museum, Supplement*, 5, 1–143.

Myers, A.A. (1991) How did Hawaii accumulate its biota? A test from the Amphipoda. *Research letters in Evolution and Biogeography*, 1, 24–29.

Nayar, K.N. (1966) On the gammaridean Amphipoda of the Gulf of Mannar, with special reference to those of the pearl and chank beds. *Proceedings of the Symposium on Crustacea held at Ernakulam from January 12 to 15, 1965. Marine Biological Association of India*, 1, 133–168.

Ortiz, M., Lalana, R. & Sanchez-Díaz, A. (2000) Una nueva especie de anfípodo espongícola del género *Hoplopheonoides* Shoemaker, 1956 (Gammaridea: Cyproideidae), de Cuba. *Avicennia*, 12–13, 63–68.

Potts, F.A. (1915) The fauna associated with the crinoids of a tropical coral reef: with especial reference to its colour variations. *Papers of the Department of Marine Biology, Carnegie Institute Washington*, 8, 71–96, pl. 1.

Rauschert, M. (1996) Erstnachweis der familie Cyproideidae (Crustacea: Amphipoda: Gammaridea) in der Magellan-Region. *Mitteilungen Aus Dem Zoologischen Museum in Berlin*, 72, 199–206.

Ruffo, S. (1938) Studi sui crostacei anfipodi. IX. Gli anfipodi marini del Museo Civico Storia Naturale di Genova. b) Gli anfipodi del Mar Rosso. *Annali del Museo Civico di Storia Naturale, Genova*, 60, 152–180.

Ruffo, S. (1959) Contributions to the knowledge of the Red Sea No. 13. Contributo alla conoscenza degli anfipodi del Mar Rosso (1) (Materiali raccolti a Ghardaqa e nel Golfo di Aqaba). *Bulletin of the Sea Fisheries Research Station, Haifa*, 20, 1–26.

Ruffo, S. (1969) Studi sui crostacei anfipodi. LXVII. Terzo contributo alla conoscenza degli anfipodi del Mar Rosso. *Memorie del Museo Civico di Storia Naturale, Verona*, 17, 1–77.

Sars, G.O. (1883) Oversigt af Norges Crustaceer med forelobige Bemaerkninger over de nye eller mindre bekjendte

Arter, I: (Podophthalmata-Cumacea-Isopoda-Amphipoda), 18, 1–124, pls 1–6.

Schellenberg, A. (1938) Litorale Amphipoden des tropischen Pazifiks nach Sammlungen von Prof. Bock (Stockholm), Prof. Dahl (Berlin) und Prof. Pietschmann (Wein). *Kungliga Svenska Vetenskapsakademiens Handlingar*, Series 3, 16(6), 1–105.

Schellenberg, A. (1953) Ergänzungen zur Amphipodenfauna Südwest-Afrikas nebst Bemerkungen über Brutraumbildung. *Mitteilungen Aus Dem Zoologischen Museum in Berlin*, 29, 107–126.

Schiecke, U. (1977) Zwei Neue Vertreter der Cyproideinae (Amphipoda: Amphilochidae) aus dem Mittelmeer: *Pseudopeltocoxa gibbosa* n.g. n.sp. und *Peltocoxa mediterranea* n.sp. *Bollettino Del Museo Civico Di Storia Naturale Di Verona*, 4, 525–542.

Shoemaker, C.R. (1956) A new genus and two new species of amphipods from Dry Tortugas, Florida. *Journal of the Washington Academy of Sciences*, 46(2), 61–64.

Spandl, H. (1924) Das Amphipoden-Genus *Gallea* (Walker). *Zoologischer Anzeiger*, 61, 243–246.

Stebbing, T.R.R. (1899) Revision of Amphipoda (continued). *Annals and Magazine of Natural History*, Series 7, 4, 205–211.

Thomas, J.D. (1999) *Moolapheonoides utmas*, new species, from Coral Reefs in the Madang Lagoon, Papua New Guinea (Amphipoda, Cyproideidae). *Bulletin of Marine Science*, 65(2), 515–521.

Vader, W. (1978) Associations between amphipods and echinoderms. *Astarte*, 11, 123–134.

Walker, A.O. (1904) Report on the Amphipoda collected by Professor Herdman, at Ceylon, in 1902. *Ceylon Pearl Oyster Fisheries – 1904 – Supplementary Reports*, 17, 229–300, pls 1–8.